Weatherwise

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The Hurricane Season Commences

American Meteorological Society

Vol. I, No. 5
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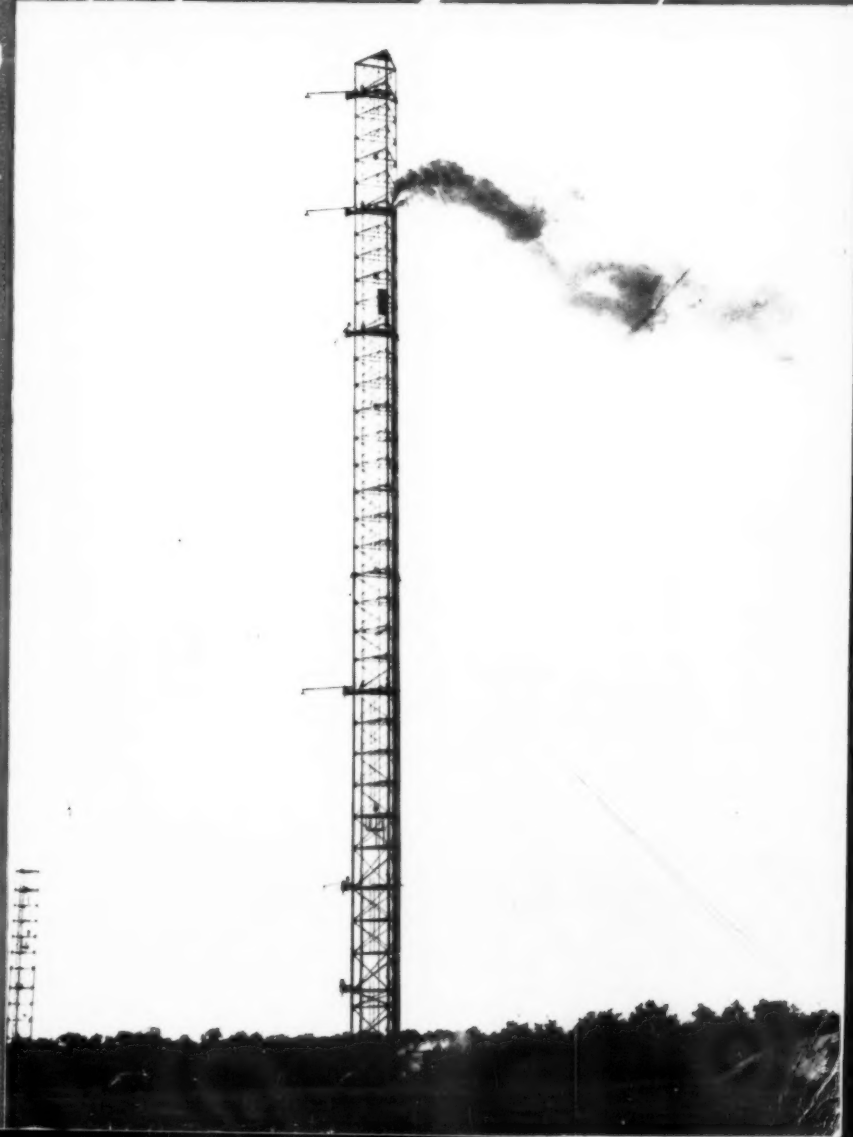

"SOME PEOPLE ARE WEATHERWISE BUT MOST ARE OTHERWISE" — BENJAMIN FRANKLIN

WEATHERWISE

THE MAGAZINE ABOUT WEATHER

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A PRELIMINARY HURRICANE REPORT FROM FLORIDA

THE HURRICANE of September 18-25, 1948, was one of about average intensity and gave winds of 122 miles per hour while passing over southern Florida. It would not be classed with the "great hurricanes" that have occurred at times in the past. Two people lost their lives in Florida, and press reports stated that 10 were killed in Cuba. Property and crop damage in the state will run to around 20 million dollars, according to preliminary unofficial estimates, mostly to sugar cane, citrus fruits, and truck crops.

On September 14th, an easterly wave was first noted east of the Windward Islands. Daily reconnaissance flights by the Navy and the Air Force kept the wave under observation as it moved westward through the Caribbean Sea. On the 18th there was a perfect "eye" about 15 miles in diameter: highest wind 60 knots, and lowest pressure 994 millibars. [See page 106.] The hurricane developed and moved very slowly to reach the southern Cuban coast east of the Isle of Pines on the 20th. By midnight that day the center was entering the Florida straits about 30 miles east of Havana, at which city 90-mile north winds were blowing. The center passed a very short distance east of the Key West Airport (Boca Chica Field) at 11:30 a.m. of the 21st. The anemometer at the field was blown away at about 100 m.p.h., but highest sustained wind was estimated at 122 m.p.h., and gusts on a gust recorder reached 160 m.p.h. The lowest pressure there was 28.73 inches.

The central eye, or vortex, was distorted while crossing Cuba, and thereafter did not reform into a true circle until it had passed Florida. Its horseshoe shape was verified by radar from the Key West naval base, and after the storm became involved with land friction in Florida it was further stretched and distorted. This gave rise to some uncertainty as to just where the center was, since points rather widely separated reported calms of various durations. Forecasters had considerable difficulty tracking the center across the Everglades, where reports were few.

The principal "center" entered Florida mainland a short distance east of Everglades City, where the anemometer blew away but estimated highest wind was 120 m.p.h. The storm passed northeastward over Lake Okeechobee and out into the Atlantic Ocean near Jansen Beach south of Melbourne in the afternoon of the 22nd.

Warnings were unusually good and timely. Hurricane warnings were posted in all areas at least 24 hours ahead of the hurricane winds, and hurricane force occurred over about 90 per cent of the area warned. No section outside of the warned area had strong winds.

GRADY NORTON
U. S. Weather Bureau
Miami, Florida

September 25, 1948

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Cover: The 420-foot meteorological tower, "Ace," at Brookhaven National Laboratory, Long Island, N. Y., during a recent smoke run. Temporary thermohm shields can be seen on booms at 150, 355, and 410 feet. Gurley wind transmitters at 410 feet are practically invisible. The black object in the tower, below the smoke source, is an elevator capable of handling 500 pounds. In the lower left corner of the picture is "King," a 160-foot tower of similar construction. (See page 95.)

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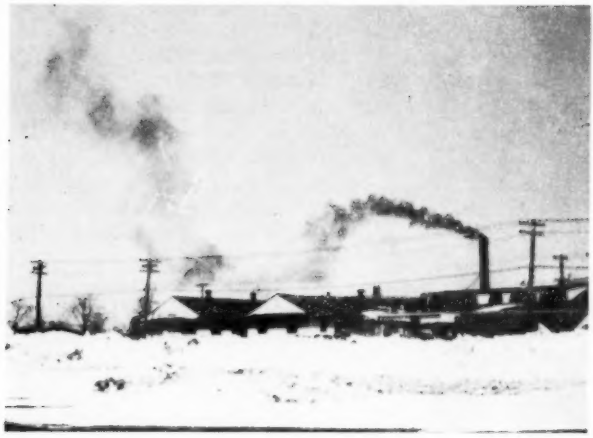


Coal smoke from the cafeteria stack, Brookhaven, February, 1948, gives an example of whipping under superadiabatic conditions.

"Princess," the 90-foot pole adjacent to the meteorology building.

Micrometeorology at Brookhaven

DAVID M. LUDLUM, DIRECTOR
AMATEUR WEATHERMEN OF AMERICA

CAN YOU SEE ANY REASON why a meteorologist should become interested in observing smoke slowly swelling out of a chimney? Have you ever noticed smoke whip, or loop, as is seen in this photograph? A micrometeorologist—who studies the small details in weather as they affect a limited part of the lower atmosphere—finds a relation between the lapse rate, the wind velocity, and the behavior of the smoke as it leaves its point of origin. Whipping and looping, for instance, are indicative of a superadiabatic lapse rate, that is, the temperature-height curve has a greater slope toward low temperature than does the adiabatic curve. Given such a condition, differential heating on the ground causes large eddies to form. You sometimes see looping on a cool, sunny day.

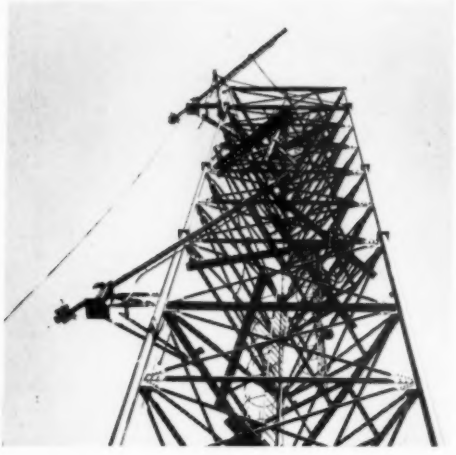
One current reason for meteorologists studying smoke behavior is found at the 6,000-acre tract 65 miles east of New York City, on Long Island, long known as Camp Upton but now the site of Brookhaven National Laboratory. According to a press release from Upton, N. Y., issued on July 22, 1948, nine universities under contract with the federal government are constructing a nuclear reactor (chain-reacting pile) for the purpose of studying nuclear energy. The reactor will be cooled by air; large fans will conduct the air away from the pile, through a duct, and up a 300-foot air stack located on a hill. In this air there will be minute quantities of radioactive argon, a well-known inert gas, which will be dissipated harmlessly into the atmosphere, but with its distribution in the surrounding atmosphere closely watched by meteorological and health physics monitoring stations.

When activities began at Brookhaven, it was essential to obtain a constant record over the site, employing facilities on hand. Several thermohms (resistance thermometers), centered under metal shields, were attached to a steel fire tower on Rutherford Hill. For data above the tower top, two airplane flights were made daily to 3,000 feet, one at sunrise, the other in the afternoon.

It was mid-January when a 90-foot pole

was erected adjacent to the meteorology building. On this, thermohms were installed at five levels: 4, 9, 18, 38, and 75 feet. (On February 24, 1948, under an inversion caused by snow cover, a difference of 11.5° centigrade was recorded between 4 feet and 75 feet.) In addition, a constant record of soil temperatures was obtained from a thermohm buried two inches below the ground surface. Wind velocity transmitters, installed at 40 and 80 feet, provided a basis for numerous comparisons.

The fire tower and telephone pole proved invaluable, and data from the 90-foot pole



A close-up of "King." Note the aspirator pipe bent out from the boom's pivoting point. Platforms at the various levels were not installed when this picture was taken.

continues to get the scrupulous attention of the meteorology statistician. Now, however, search for continuous weather data extends to 420 feet above the ground, for the meteorological tower which is nearing completion is comparable in height to a building of 35 or 40 stories (see front cover). Another tower, 160 feet high, stands a short distance to the west. Between the two, electrified cables will carry instruments on a "traveler," giving measurements of temperature and wind along the horizontal.

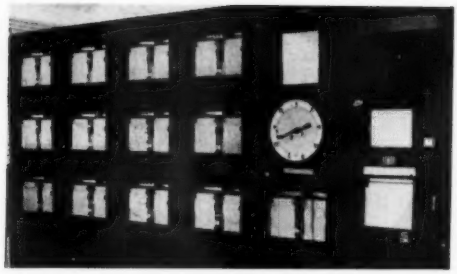
The towers are similar in construction: triangular, with 18-foot sides at top and bottom; upright legs of tubular steel; tubular cross members; channel bars, back to back, at the platforms. "King," the smaller structure, is void of any supporting guys, whereas "Ace," the tall tower, has nine steel cables divided between three levels. Workmen on top of the tower during a recent windy morning reported, "It doesn't sway, it twists!"

At five levels on King, and at eight on Ace, there are platforms from which special observations can be taken. Extending from these same platforms are tubular booms which can be pivoted through 315 degrees. Recently, the booms were temporarily equipped with instruments at three levels; before long, they will house Friez Aerovanes and Gurley transmitters for wind velocity, and Leeds and Northrup thermohms for temperature.

Each of the latter will be shielded by an aluminum cylinder within a cylinder, so constructed that rain and ice, as well as sunlight and ground radiation, will not penetrate to the copper element. An aspirating system attached to each thermohm shield will draw air through the core at an average rate of 10 cubic feet per minute. The temperature drop caused by such a flow is extremely minute — readings will be representative of the free air.

A resistance-type thermometer makes another demand for accuracy besides proper exposure. Three leads extend from element to recorder, and it is imperative that the designated two of the three be of the same length. However, it is a simple matter to gain, or lose, a fraction of an ohm over the distance of 900 feet from Ace to the 12-point Micromax recorder in the Meteorology Towers building. In order to maintain an accuracy of 1/10 of a degree, the recorder is specially equipped with built-in variable resistors. The turning of a knob, corresponding to a thermohm, automatically corrects for errors in resistance, or "drifting."

The Micromax to which reference has just been made is located in the lower right of the recorder panel, pictured here. A similar instrument, but with fewer points, is to be installed in the vacant section in the upper right, to record temperature data from King. The circular frame in the panel is also a Micromax recorder, known as the Model R. This performs virtually like a calculating machine: it provides a record of differences in temperature between any two thermohms.



The recorder panel in the Meteorology Towers building.

Present plans call for obtaining a running record of differences between four feet and 410 feet on Ace. To the man on watch, this will provide a primary indication of lapse rate, or of inversion conditions. The detailed distribution of temperature will be observed on the Model S Micromax chart.

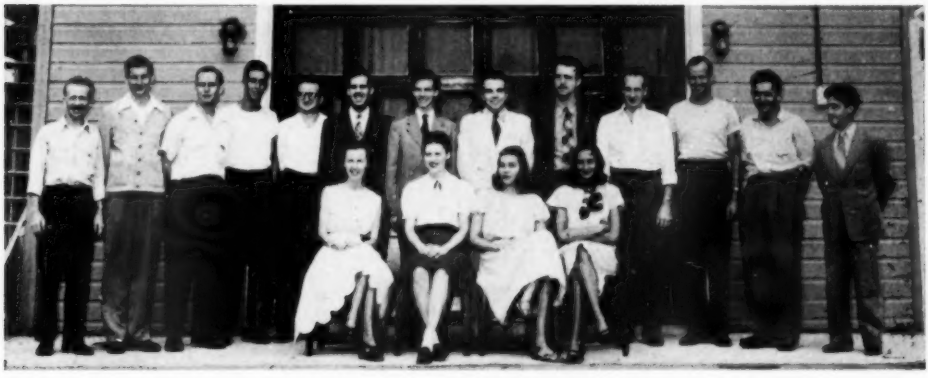
The rectangular instruments seen in the panel are Gurley and Aerovane wind recorders. Normally, they are geared to feed four inches of record each hour, but a special gear ratio makes it possible to accelerate for a "speed run," simply by pushing a lever. Two clocks, to be installed in the remaining vacant space above the Model R, will automatically time-check each chart every 10 minutes, or every 10 seconds, as during a speed run. Accelerated chart speeds give greater definition to the traces of wind speed and direction, thereby making it possible to study and interpret the meaning of turbulence.

Still missing from the panel is an instrument which has yet to make its debut to the world of weather-watchers. To facilitate the study of vertical wind gradients, this instrument will record wind movement and direction at one level, and the differences in such wind data between this level and two other levels.

Given all this data, some seven miles of record for a single year of operation with the panel, what will be done with it? At Brookhaven, the concept of "meteorological control" implies an acceptance of climate and a full recognition of weather, but with meteorological observations and research resulting in special advisories geared to the requirements of nuclear research.

First, the construction and planning engineer can design his reactor facilities for maximum economy of construction and operating efficiency if he shares the expert knowledge of the micrometeorologist at the laboratory. Second, with complete information on temperature and wind currents at upper and lower levels, together with a knowledge of the weather on Long Island and throughout the country, scientists are assured that operation of the reactor will be harmless to neighboring communities and plant life in the vicinity. The data obtained from the towers is basic to this step of meteorological control, which makes demands for attention 24 hours a day, seven days a week. This second step involves a day-by-day, hour-by-hour account of the weather, together with an analysis of that which has occurred.

At Brookhaven, the forecasts are of two types: general and micrometeorological. All forecasts come under the supervision of the



Members of the meteorology group and USWB office personnel at Brookhaven.

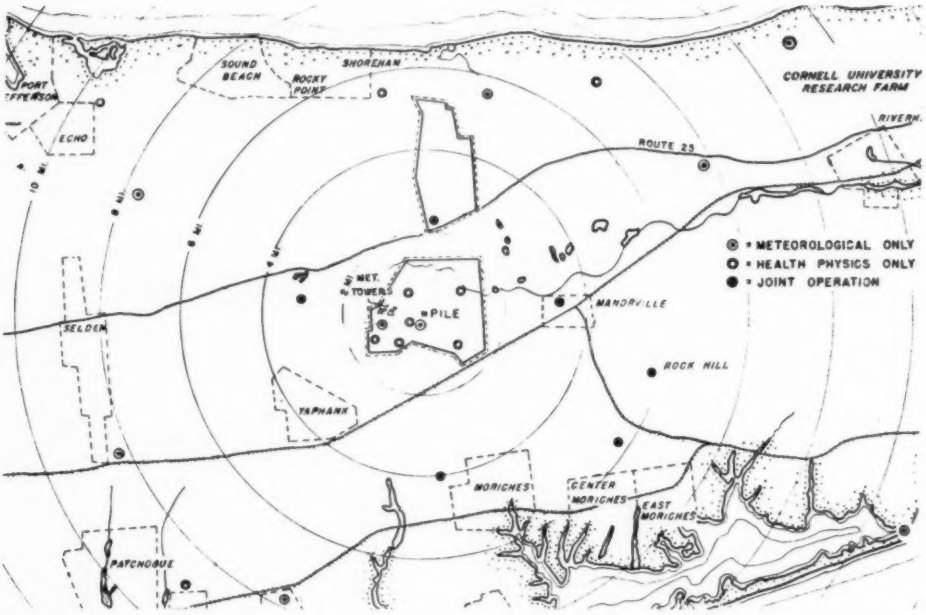
senior forecaster. The importance of the towers is growing. The "micro" fluctuations observed for Brookhaven are examined in terms of the "macro" changes seen in the daily surface maps, the constant pressure charts, the upper winds, and the pertinent raobs.

The focal point of meteorology at Brookhaven is smoke behavior. Pictures and notes on the smoke coming out of the central heating plant stack were made as routine this past winter. The particle size of coal smoke is much larger than ideal for the program, so its study was a temporary expedient until the recent installation of an army surplus M-1 smoke generator in a concrete pit near the taller tower. This generator is similar to those used in laying down smoke screens during the recent war. A small pipe buried in the ground extends from the generator pit to the base of Ace, where it is introduced into a manifold of numerous small jets. It is here that the harmless oil fog smoke is produced. From this point the oil fog travels up a 20-inch steel pipe stack to a height of 355 feet. The 10,000 cubic feet per minute produced at the jets find no difficulty in forcing their way out of the upper orifice. Nevertheless, another concrete pit a short distance away houses a large blower driven by a 30-horsepower motor. The intake of the blower can be varied to control the flow of smoke at the top of the stack.

On August 23rd, observations of this oil fog were made for the first time. The meteorology staff worked in four units. Two men operated in the generator pit, one at the controls, the other as a log man and co-ordinator. A third man checked equipment in the fan pit, read periodic temperatures at the base of the stack, and stood by for any emergency. There were two mobile units, one covering photographic details, while the other sampled the air surrounding the site with specially built photoelectric densitometers. The dilution of the oil fog with the air was indicated on a meter in the mobile unit as it moved in and out of the smoke cloud.

Meanwhile, the recorders in Meteorology Towers were set on speed runs, and repeated surface observations were taken at the build-

(Continued on page 107)



The section of Long Island centered on Brookhaven. Some micronet stations are situated outside of this area.

Frost Prevention by Radiant Energy

A. W. FARRALL, HEAD, AGRICULTURAL ENGINEERING DEPARTMENT, MICHIGAN STATE COLLEGE

ORCHARDISTS, truck growers, florists, and other growers of high-value crops have for years desired an effective, yet simple and inexpensive, means of protecting these crops against frost damage. This damage often results in losses of more than $100,000,000 per year in the United States alone. The problem is world wide, as evidenced by inquiries received from most of the principal countries of the world regarding frost prevention by radiant energy.

Many methods have been used to combat frost. The most effective, heretofore, have been found to be smudge pots, air circulation, and water spray. Each of these is effective under some circumstances, but the dependability is not all that is desired and, in many instances, the cost and labor requirements are prohibitive.

The problem was brought forcibly to the attention of the agricultural engineering department of Michigan State College in 1945, when for several successive years the loss from frost damage was more than $10,000,000. A research program was set up to study the problem and after some experiments with air circulation, including the use of a Sikorsky R-5 helicopter, it was decided to try radiant energy in the infrared range.

Several conditions influenced this decision. First, it was known that most of the frosts which cause damage are of the radiation type, when, on a clear night, the earth loses nearly a million B.T.U.'s per acre per hour to the atmosphere. Secondly, it was thought that radiation would be an effective method of directing heat energy to a given place. For example, in the past, the heaters employed were principally convection-type heaters and there was no effective method of directing the heated air down onto low-growing crops, since heated air rises. By radiation, on the other hand, energy can readily be directed toward the ground or other objects.

It was reasoned then that if an amount of energy approximately equal to that lost per hour per acre could be radiated back onto the ground or vegetation from an artificial source, the frost damage could be prevented.

In order to test this theory, a 20-kilowatt electrically heated unit was designed and built at Michigan State College in the spring of 1946. At the same time, the project was brought to the attention of the Detroit Board of Commerce research committee and their co-operation obtained in carrying forward the development.

The Evans Frostguard, developed at Michigan State College. The model shown is powered by a six-volt battery.

Results of tests on three different frosty nights in May of 1946 proved conclusively that the theory was sound and that radiant energy was indeed a very effective method of preventing frost damage on low-growing vegetation. A plot 40 feet square was protected by the electrical unit against temperatures as low as 28° F.

The apparatus consisted of chromalox heating rods set at the proper relationship to an aluminum reflector and placed about 12

feet above the ground. It was recognized that electricity, while satisfactory for a small plot, would be impractical for large-scale operation on account of cost of apparatus, cost of current, and lack of available power lines. It would require about 400 kilowatt-hours per acre to give satisfactory protection.

The logical source of fuel for a large unit was oil or gas. It was decided that an attempt should be made to design a unit which would protect about an acre of ground. One problem was to design a burner and radiation generator of sufficient capacity and then to develop a means of distributing the energy effectively. The latter was the more difficult because the inverse square law rules that the radiation intensity decreases as the square of the distance.

After many laboratory tests by F. J. Hassler and his associates, several different designs were constructed. Essentially, the unit consists of a large generating-type oil burner which operates on kerosene, a radiating device, and a reflector, in addition to fuel pump and tank. The specific form of the radiation surface and the reflector are of great importance from the standpoint of radiating efficiency and cost.

In operation, the burner generates about 1¼ million B.T.U.'s per hour. It heats the generating surface to a temperature of about 1,500° F. and, at this temperature, a high percentage of energy is given off in radiant form. Part of the energy is radiated directly onto the plants, while additional energy strikes the large reflector and is redirected down onto the vegetation. Numerous tests indicate that the unit burns about 10½ gallons per hour and that it is quite effective as a positive large-scale frost prevention device.

In order for the units to be most effective, they should be used in groups so that each unit helps the other. Under certain conditions, one unit by itself will protect about 4/10 acre, but if used with a group, the effective area will be between ¾ and one acre.

The standard machine is about eight feet high to the base of the generator, making an overall height of about 13 feet. Power for the fuel pump is furnished either by a six-volt storage battery or 110 volts, as may be available. The power requirement is about 1/30 horsepower.

Tests of the unit demonstrated that sensitive plants, such as tomatoes, geraniums, and the like, could be protected out at distances of 100 feet against frost when the air temperature was as low as 26.5° F.

Patents have been applied for by Michigan State College in the United States and several foreign countries, and the exclusive marketing and manufacturing have been turned over to the Detroit Agricultural-Industrial Foundation, who have arranged for a manufacturer. The first 100 units were produced in the spring of 1948 and regular production is now under way. The unit will be sold under the trade name of Evans Frostguard.

Limited experience with the first units in commercial operation has demonstrated that the radiation method is quite effective in protecting strawberries, currants, flowers, and the like. It is also believed to be quite adaptable to the protection of many other types of plants and trees. Some suggested uses are: *Vegetables* — Earlier planting, longer bearing; *Berries* — Better yield, greater assurance of crop; *Flowers* — Earlier planting, longer bearing; *Deciduous trees* — Apples, cherries, etc., spring protection; *Truck farmers* — More frequent plantings, earlier planting, longer bearing; *Protection of outdoor workers*—Shipping docks, construction work, etc.; *Construction* — Setting cement, etc.; *Protection of animals* — At lambing seasons, etc.

Further development of this radiation-type frost prevention equipment is being carried on by Michigan State College, for it is believed that the full development of the method will result in enormous savings each year to American agriculture. Much information is still needed relative to the most efficient methods of generating infrared energy, and how best to apply it to all types of vegetation.

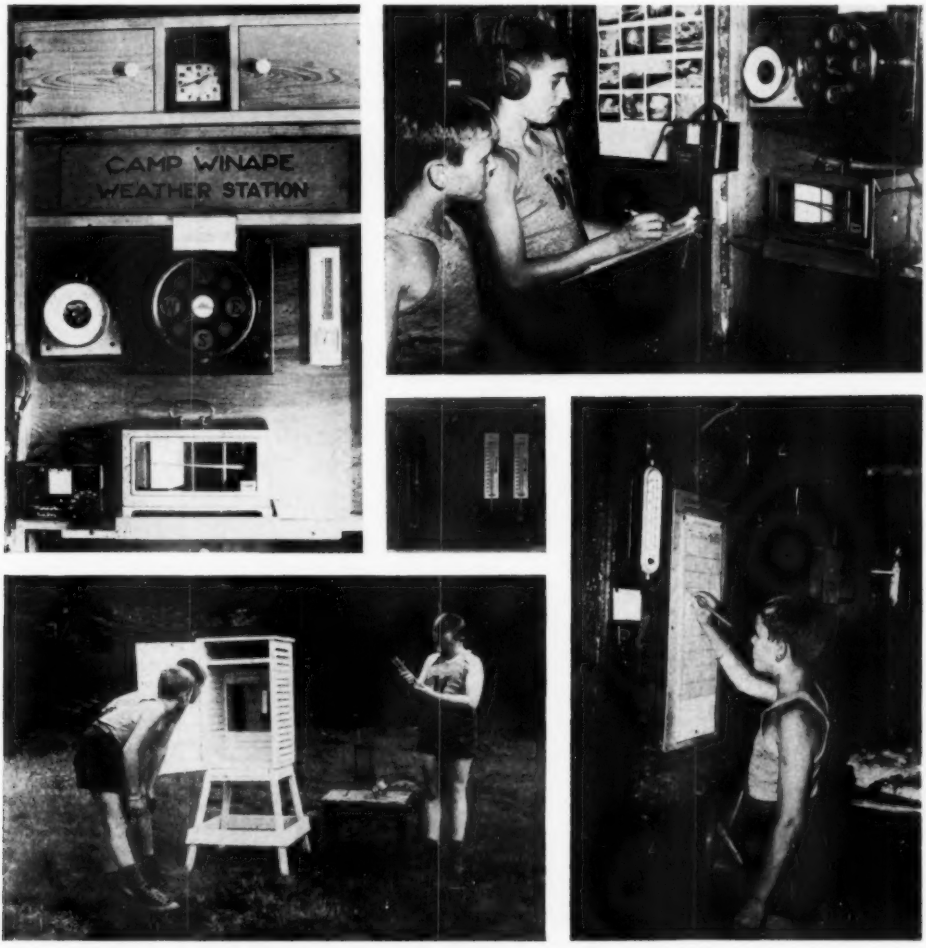
AWA WINTER PROJECT

The winter activities of the AWA will center around a snowfall and snowflake study project. Observers will be requested to note the time of beginning and ending of snowfall and to make frequent measurements of the rate of fall. A special kit to preserve snowflakes in plastic will soon be introduced through the AWA to assist work on this project.

Amateur Weathermen of America

CAMP WINAPE, a boys camp at East Charleston, Vermont, now has an up-to-the-minute weather service, provided during the 1948 season by several members of the AWA. As shown by the accompanying photographs, the weather station was operated by the boys at the camp. Complete weather observations were recorded several times daily, and a bulletin board was kept up to date with weather information.

An important duty of the camp weatherman was to provide Camp Director Edward Kolar with information on anticipated weather changes. Not only were the latest weather forecasts copied twice daily, but the airways sequence reports were checked hourly for late developments. The program, according to Mr. Kolar, helped greatly in the efficient scheduling of outdoor activities. An expanded program is planned for 1949.



Operating the Camp Winape weather station: (upper right) Ronnie Kolar and Teddy Dieffenbach; (lower left) Teddy and Ronnie at the shelter, David Trubek at the rain gage; (lower right) Teddy. Photos by the Derick Studios.

THE BARRENS OF PENNSYLVANIA

WILLIAM S. CLARKE, JR., DEPARTMENT OF HORTICULTURE
PENNSYLVANIA STATE COLLEGE

THE EXISTENCE of frost pockets, which are areas of low ground with night temperatures much below those of the surrounding country, is well known to most weather observers. In central Pennsylvania there is a region known as the Barrens, much of which is a frost pocket on a large scale. This region is very interesting on account of the character of its vegetation, which is so different from that of the surrounding country. Over large areas the land is covered with scrub oak and bushes, mostly about waist-high, along with scattered groups of pitch pine and aspen trees and many flowering plants, quite unlike the forests of large oak trees covering the adjacent country.

At one time the higher ground of the Barrens was covered with a forest of oak and chestnut, while the lower ground contained a pine forest. The original forest was lumbered off many years ago, but where the fires have not been too recent, the higher ground is again being occupied by an oak forest. In the low ground the natural pine reproduction has been killed by fires, and the land is now covered largely with the scrub growth just mentioned.

The Barrens occupy a tract of land about 10 miles long and two to three miles wide, coming to within two miles of the town of State College in Centre County. Throughout the heart of the Barrens is a broad valley about three miles long and more than a mile wide covered with these small scrub oak trees. At its lower end the Gatesburg Ridge, a low hill two to three hundred feet higher than the valley floor, blocks the downward movement of cold air on still nights. The only outlet of this valley is a narrow pass a few hundred yards wide through this ridge. The blocking of air movement causes the cold air to pile up, and evidently the cold intensifies, for temperatures lower than those reported at any of the weather stations in Pennsylvania are often recorded here on still, clear nights.

Beginning in 1941 a study has been made of the low temperatures in the Barrens and their effects on the vegetation. A maximum-minimum thermometer (Six's type) was hung on the north side of one of the pitch pine trees at the edge of a grove in the middle of the valley. These trees have a sparse foliage and exert practically no canopy effect to modify the night temperatures. Readings

The trees on the far hill are in leaf, bushes in the hollow are not. Photo by the author.

have been taken about once a month and sometimes more often, particularly in the period of spring frosts. One year a thermometer placed on the Gatesburg Ridge showed that minimum temperatures there were normal for the region, similar to those in State College. More recently two thermometers have been placed in the low ground of the Barrens about two miles apart, and they have always given readings within three degrees of one another.

The lowest winter temperature was −40° F., recorded in January, 1942. Other lowest winter temperatures are as follows:

Year	*Temperature degrees F.*
1942 - '43	−30
1943 - '44	−18
1944 - '45	−25
1945 - '46	−24
1946 - '47	−9
1947 - '48	−32

Following the low temperatures of 1942 and 1948 most of the scrub oak trees and some of the bushes were found to have been killed back to the ground or to older wood.

In two different years minimum temperatures for May have been as low as 7°, and all recorded minima for the month have been lower than 20°. In five years June minimum temperatures have been between 20° and 22°. In six out of eight years the spring frosts have killed all the new growth on scrub oak (five years in June, and one year on May 31), and they have often damaged blueberry and other bushes and some annual plants.

Below-freezing temperatures have been recorded in July in five years out of eight; and in August, four years out of seven. In September some very low temperatures have been recorded, with the lowest 8° in 1943. This temperature and one of 10° in 1947 killed most of the foliage of the scrub oak and many bushes and small plants.

The low temperatures in the spring hold back the vegetation in the valley so that it is several weeks to a month behind that on the hills. The valley is still brown as it is in winter, while the hills are green with new growth. The cold air seems to lie in the valley very much like water in a lake. The border between the green vegetation of the hills and the brown, dormant shrubs of the valley is very sharp. Near the border the

An aspen tree with its lower branches dormant. Photo by the author.

tops of trees sometimes come into leaf while the lower limbs are still dormant. The frost line is also very sharp; sometimes the top of even a small tree may be green while the leaves on the lower limbs may be black and withered. It is probable that the low temperatures of winter and spring prevent the growth of the large oak trees normal to the region, and that the Barrens will retain their present character for a long time to come.

The low temperatures recorded in the Barrens are often much lower than those reported at any of the weather stations in Pennsylvania, even in such cold spots as Kane, Somerset, and other mountain stations. A few random comparisons follow:

Date	*Temperature in Barrens, degrees F.*	*Coldest elsewhere in Pennsylvania*
May, 1941	7	21
June, 1941	22	31
January, 1942	−40	−30
September, 1942	12	19
December, 1942	−30	−25
March, 1943	−23	−15
July, 1943	25	31
September, 1943	8	18
March, 1944	−14	−6
June, 1945	22	27
December, 1945	−24	−22
June, 1946	22	23
May, 1947	7	16
September, 1947	10	17

Air Force Reserve Flight

IN ACCORDANCE with an increased emphasis placed on reserve officer training in the Air Force, on June 28th a group of 16 ex-Air Weather Service officers completed a two-week active duty nation-wide tour of the principal Military Air Transport Service weather installations in the United States.

This first group to be selected for such a special tour of active duty includes two colonels, four lieutenant colonels, four majors, and six captains. They are officers who held key positions in the Air Weather Service during World War II.

The group convened at Mitchel Air Force Base, N. Y., on June 14th and flew to Washington, D. C. There they inspected the Air Force's world-wide weather forecasting office, the Master Weather Analysis Unit; the joint Weather Bureau-Air Force-Navy weather central, forecast issuing agency for all weather stations in the U. S.; and Air Weather Service headquarters at Gravelly Point, Va.

The reserve officers next flew to New Orleans, La., to visit the Data Control Unit. They reviewed the unit's modern mechanical filing system of historical weather information submitted by weather agencies of the Weather Bureau, Air Force, and Navy from all parts of the world.

At Oklahoma City the officers attended conferences with the staff officers of the 59th Weather Wing and discussed the overall objectives and accomplishments, and special projects of the wing. The group also witnessed a field demonstration of a mobile weather unit.

The reserve officers had a six-day visit with the 308th Reconnaissance Group at Fairfield-Suisun, Calif. Here each of the officers was afforded an opportunity to participate in a B-29 weather reconnaissance flight over the Pacific. The 308th demonstrated its training program for reconnaissance flight personnel, the utilization of modern electronics and radar in weather observation, and special B-29 aircraft modified to serve as flying weather stations.

The reserve group then returned to Mitchel Air Force Base, thus completing the tour.

With the accelerated U. S. Air Force 70-group program, this two-week air tour represents part of a continuing plan to keep reserve air weather specialists abreast of developments in new devices and techniques for weather observing and forecasting.

Escort Officer Captain Jan W. Janssen, front row left, and the 16 reserve officers who participated in the tour.

Frost Control with Air Circulators

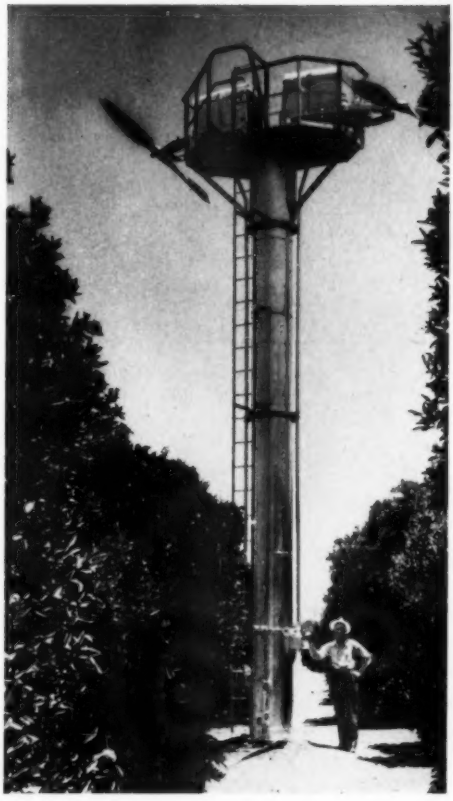
WIND MACHINES have been used in California for the past 10 years to combat frost. On a clear, cool night with active radiation, the temperature at a height of 45 feet may be 10 degrees warmer than the air five feet above the ground. A wind machine breaks up this stratification of the air and causes vertical mixing of the warm air with the cooler air at fruit level.

The machine illustrated here, marketed by the National Frost Protection Co., Inc., of Glendale, Calif., consists of a tubular column 30 feet high, 24 inches in diameter, on top of which are mounted two 100-horsepower engines. The propellers, each 11½ feet long and of solid aluminum alloy, are connected to the engines through a transmission. Each propeller turns at 900 revolutions per minute and moves approximately 300,000 cubic feet of air per minute at a low velocity, since the blades are set at a very flat pitch.

The tubular column is mounted in a base block of concrete eight feet square weighing 8½ tons, reinforced with 350 pounds of steel. The machine is entirely controlled from below, with visual temperature, ammeter, and oil gages. The center column holds 600 gallons of gasoline, which is sufficient for 40 hours of operation, at a cost of approximately $2.50 per hour.

The distributors state that one machine will protect up to 40 acres of deciduous fruits and up to 20 acres of citrus, depending on the heights of the trees and the density of the foliage. The division of agricultural engineering of the University of California has studied the operation of more than 1,000 such machines now functioning in Southern California. A recent report on this study points out the value of a wind machine in raising the temperature of orchards at critical times by a degree or two. This is accomplished at a relatively small expenditure for labor. The report emphasizes, however, that wind machines are of little value in combating a "deep-freeze condition," when polar continental air spills over into the Pacific Coast area, bringing a constant flow of below-freezing air. In such periods all present methods of frost protection fail.

The report goes further into the subject and points out that the fundamental problem in the protection of orchards from radiation frost damage lies in the thermal condition of the ground. During a cool, still night, heat flows from the ground to the fruit and foliage. The problem is to get the maximum amount of heat into the ground during the day so that there may be an adequate reservoir of heat to flow to the chilling foliage at night.



Model DM Tropic Breeze machine. Photo by Richard M. Esgate.

CALIFORNIA AWA

Weatherwise fans in Southern California are holding an organization meeting in October. Interested persons may contact W. Thomas Johnston, 118 Lincoln Ave., Pomona, Calif.

The tracks of recent hurricanes, with positions for 1330 each day plotted roughly. See page 94 for further information on Storm V.

THE HURRICANE SEASON COMMENCES

D. C. CAMERON

THE 1948 hurricane season made a late but sudden start, in the early morning of August 26th, when two freighters, one American and one Russian, encountered severe weather in the vicinity of 20° north latitude and 60° west longitude, to the northeast of the "bend" in the Lesser Antilles. Reconnaissance flights into this storm, which is No. I on the chart, tied it down on a northwesterly course moving between 15 and 20 miles per hour on the 26th. On the 27th, there was some confusion in locating the center, but apparently it continued on its northwesterly course, and by the morning of the 28th its speed had decreased to about 10 or 12 miles per hour. Ships had scooted from its path, and weather flights comprised the only clue to its increasing intensity and coverage.

At 5:30 a.m. of the 29th, the center of Storm I was about 450 miles southeast of Wilmington, N. C. By the next morning it had commenced a slow turn to the north, and hurricane warnings were hoisted on the coast from Wilmington to Hatteras, with storm warnings down to Charleston and up to the Virginia capes. By the morning of the 31st, the storm was 140 miles south-southeast of Hatteras, after which it picked up speed and definitely headed northeast, enlarging into a severe extratropical storm. Hatteras had strong but not damaging winds. By September 1st, Nantucket was blowing force 6 from the north, with the storm center some 250 miles away. All that day, Nova Scotia, especially Cape Breton Island, felt the storm's full impact, with sustained winds of 65 miles per hour lashing Sydney for over six hours.

It was fortunate that this storm spent its earlier hurricane strength over the open sea, as it was a very severe disturbance. It raced northeastward over Newfoundland to reach the southern tip of Greenland by midday of September 3rd.

Storm II could hardly be called a hurricane, but did develop a closed circulation and crossed the Lesser Antilles near St. Lucia on the evening of August 31st on a westerly course. During the morning of September 1st, it moved slowly into the Caribbean Sea. It was last reported on at 2300 on the 1st, near 15° north and 66° west, where it had diminished to minor strength. It is quite possible that it may have been the swells and rough seas of this storm in which the overloaded circus ship *Euzkera*, bound from Cuba to Colombia, foundered with the loss of 37 human lives.

Storm III was a long time in the making. A slight circulation in the extreme southwest Gulf of Mexico, first indicated on the weather map on August 31st, failed to develop real storm character until sometime during the early morning of the 3rd. During the day it moved rather rapidly northeastward toward the lower Louisiana coast, where hurricane warnings went up. It reached the coast by midnight and passed almost directly over New Orleans between 0800 and 0900 on September 4th. At Moisant International Airport the lowest pressure was 989 millibars (29.20 inches) and the highest sustained wind was 65 miles per hour, with gusts at 85. Rainfall totaled nearly seven inches in some parts of the city. From the high tides, several rebuilt piers along the Mississippi coast, hard hit by 1947's severe storm, were again destroyed. The storm passed northward with rapidly decreasing intensity, and disappeared as a complete circulation in central Illinois on the 6th of September.

The fourth storm originated north of the Lesser Antilles and on September 13th passed

very close to Bermuda, where winds in the neighborhood of 100 miles per hour were recorded. The lowest pressure was 994.2 millibars (29.35 inches). News reports stated that no loss of life occurred, thanks to advance weather advisories, but that there was considerable property damage, and all power failed on the islands. The subsequent positions for the storm are shown on the chart. Its last reported position was at 53° north, 40° west, on September 16th at 5:00 a.m.

A small tropical hurricane centered about 500 miles south of Miami on September 19th was moving very slowly west or west-northwest across the Caribbean Sea (Storm V in the chart). The Miami Storm Warning Center reported the disturbance was located about 60 miles southwest of Grand Cayman Island, with winds of about 75 miles per hour over a very small area near the center. The storm's forward movement was estimated at from six to eight miles per hour.

MICROMETEOROLOGY AT BROOKHAVEN

(Continued from page 98)

ing. Before long, the building will be a central clearing point by means of a radio communications system with the pits and the mobile units. The recent experiment was photographed only in stills (see front cover), but future runs will be by moving picture cameras located on the periphery of a designated area. Then wind traces and the width of dispersion as seen in the pictures will offer a means of correlation.

A smoke run is not over when the generator is shut down. Correlation of the weather with the behavior of the smoke will be made for all kinds of conditions. It is by this plan—observing, photographing, measuring, and calculating—that the insight vital to the scientists operating the pile will be gained.

Except for the mobile units, which make observations both on and off the site, mention has not been made of the off-site facilities. The meteorological stations are shown on the map (page 98), and radiation monitoring stations of the health physics group of Brookhaven. In the inner circle, there are five cases where Gurley recorders are housed in health physics shelters, transmitters being exposed from an adjacent 40-foot pole. A cotton-region-type shelter in the vicinity provides data from a hygrothermograph, a maximum and a minimum thermometer. In one of these five locations, an old army radar tower stands 372 feet above sea level and offers an excellent opportunity for comparisons with information obtained on Ace.

The outer network of stations provides temperature, humidity, and rainfall data. Through the courtesy of the Weather Bureau, at Westhampton Beach mutual gain is derived from a triple register installed on the bridge between that beach and the mainland. While the Weather Bureau lent the equipment, Brookhaven supplied the manpower and instructions for the installation. Now, it is the bridgekeeper of the Suffolk County highway department who changes the charts and inks the pens. Major repairs are handled by Brookhaven technicians. Suffolk County uses the data in connection with a study on beach erosion, while Brookhaven particularly makes use of it for studies of sea breezes along the south shore.

A similar venture of co-operation is now being completed with the Long Island Vegetable Research Farm, of Cornell University, situated north of Riverhead. On the south shore, southwest of the laboratory, a nationally known paint company has expressed a desire to co-operate in maintaining meteorological instruments at its testing station.

Any mention of the micronet cannot be complete without note of the co-operation by farmers and housewives on whose property the instruments are located. Inspection of instrument shelters is encouraged, and the people of Long Island have proven to be genuinely interested.

The Brookhaven meteorology group is headed by Norman R. Beers, formerly associate professor of aerological engineering at the Naval Post Graduate School, Annapolis, Md. Working with the group is a special station of the United States Weather Bureau, under Raymond C. Wanta. Others working with Mr. Beers in the supervision of the weather project are Maynard E. Smith, formerly of American Airlines; Philip H. Lowry, aerological officer aboard the seaplane tender *Albemarle*, at the Bikini atom bomb tests; and Daniel A. Mazzarella, formerly of the Weather Bureau.

AMERICAN METEOROLOGICAL SOCIETY

NOTES ON THE 100TH NATIONAL MEETING

PRACTICAL METEOROLOGY as applied in modern industry and agriculture was stressed at the 100th national meeting of the American Meteorological Society, at the Franklin Institute, Philadelphia, Pa., on September 10th and 11th. Several papers illustrated, also, the importance of theoretical studies in all phases of weather science. For instance, Vincent J. Schaefer, General Electric Company, described the formation of snow crystals in airborne dust particles, and August Rapest, Aerophysics Institute, Inc., discussed the problem of airflow over an extended ridge. Some of the other papers are reported below.

Vegetables and Climate

Peas — thousands of acres of them growing on Seabrook Farms in southern New Jersey — have since 1946 been the subject of intensive research by Professor C. W. Thornthwaite, Seabrook staff meteorologist. Because of an early spring in 1946, peas had been planted several weeks early. Assuming a normal time for their growth, they were expected to be ready to pick about May 10th. But 700 laborers available at that time had to wait until nearly June 1st, the normal maturing date for peas at Seabrook, before the crop was ready for harvesting.

Seabrook Farms and Deerfield Packing Corporation are together the largest integrated producers of frozen foods in the country — the farm's 22,000 acres are supplemented with from 25,000 to 30,000 contract acres. Professor Thornthwaite now integrates planting with weather, but puts the main emphasis on planting to insure maturity to meet a pre-arranged harvest schedule. Formerly, men labored 24 hours at a time in order to pluck an entire crop at the proper stage of maturity. The labor force now required has been reduced more than one half by the intelligent use of climatic statistics.

The Seabrook meteorologist even turned agriculturist to discover that the same peas which in 1946 took nearly three months to mature would grow in half that time in the summer, and with nearly double the yield. Professor Thornthwaite also pointed out the benefits of irrigation even in the relatively humid climate of the eastern seaboard. By irrigation, the effects of the almost annual dry spell in August and September can be greatly mitigated.

Hail Insurance

Hail is the only weather element for which crop damage is extensively insured by the stock fire insurance companies in the United States. Since 1880, when a Connecticut company branched out into hail insurance for the tobacco crop, farmers have availed themselves of this protection, sometimes in the early days causing complete collapse of their insurers, who had to guess most of the time what rates to charge. Now such rates as 3% for eastern Nebraska and 18% for the western end of that state are based on decades of premium and loss records of over 60 stock companies.

Main concentration of hail insurance is in the Middle West. Wheat leads other crops with 39 per cent of all such coverage; tobacco is next with 21 per cent; corn, 15 per cent, and oats seven per cent. Insurance is on a value per acre basis, and a crop must be above the ground and growing before a hail insurance policy can take effect. Since the war, the Crop-Hail Insurance Actuarial Association has been formed. Richard J. Roth, its consulting meteorologist, outlined a current program of correlating meteorological and insurance statistics with an aim to improved rates and claims adjustments. A project to map the frequency of hailstorms in every county in the country is under way. Mr. Roth showed pictures of crop damage in a particularly heavy storm in Iowa on July 8, 1940, to illustrate how a relatively large area could be totally devastated by hail.

East Coast Storms

From one half to three quarters of the annual subminima flying conditions in the New York area are caused by secondary developments along the Middle Atlantic Coast of sudden birth and quick movement. At least two occurrences of this phenomenon may be expected every month, and in January the number reaches four. Thus, they are the major forecasting problem in the area. All storms of this type from 1935 to 1948 have been analyzed by the staff of Eastern Airlines, and J. J. George, presenting the results of the study, said that no sure way of predicting the speed of movement of the secondaries had been found. Apparently, the winds at the 700-millibar level determine the maximum speed possible, but there may be great variation in the speed of a single storm below this maximum.

He has found that the location and contours of the high-pressure area to the north play a big role in the movement of secondaries and determine the type of precipitation to be expected. When the high is located to the east or north of the secondary disturbance, precipitation at New York is likely to be in the form of rain or snow changing to rain. With the high to the northwest, snow may be expected, and the fall may be heavy, as was illustrated by the record-breaking storm of December, 1947 (see WEATHERWISE, February, 1948, page 5, and April, 1948, page 36). In general, when the

isobars of the high are oriented east and west, the secondary development will be marked, the storm severe, and its movement slow.

The Disdrometer

An instrument which measures continuously, from an airplane, the size distribution of drops of rain encountered in flight was described by Robert E. Katz and George A. Wilson, of the weather radar research project at Massachusetts Institute of Technology. This "distribution of drop-size meter," or "disdrometer," utilizes a photoelectric pickup in which the reduction of light intensity as each drop passes through a beam of light results in a voltage pulse. The maximum amplitude of this pulse is a unique function of the size of the individual drop. Results from preliminary flight measurements were presented by Mr. Katz.

Tornadoes Near St. Louis

Edward M. Brooks, of St. Louis University, reported on his study of 14 tornadoes which occurred this year within 30 miles of the city, at the surface on four days and aloft on three other days. They were observed at all times of the day and night, and there were as many as four and five tornadoes each on two days. Most were accompanied by thunderstorms, hail, and rain, but some had no associated electrical activity or precipitation.

While these tornadoes usually occurred with the normal synoptic patterns, there were a few north of a warm front and a tornado was found aloft on the west side of a stagnant warm high. On March 19th, a "tornado cyclone" about five miles in radius was found surrounding a tornado near St. Louis. This cyclone apparently contracted and intensified, becoming a destructive tornado in Illinois. Mr. Brooks described and explained the movements of tornadoes over rough terrain, their skipping over hills, and their channeling along bluffs parallel to their paths, the higher land being on the right looking downwind.

The Missouri meteorologist suggested that damage from these storms could be reduced by better building construction, and deaths reduced by advance advisories and the preparation of proper shelters. A tornado funnel tracked on the southwest side of a city should occasion warnings by the Weather Bureau to that city.

Factory Operation and Meteorology

For many industrial problems, forecasting is not most important. The work of C. A. Gosline, meteorologist for E. I. du Pont de Nemours and Company, Inc., requires that he keep a climate file for quick reference, that he have weather statistics available firsthand, and that he know the physics of the atmosphere and the earth as affected by the weather at all seasons of the year for numerous situations where factories may be located or projected.

Typical is the problem of stack disposal of waste gases. Should all waste be sent through one stack or divided among several? A table of characteristics of various stack heights is essential, and if the waste consists of solids or mist-forming particles which fall rapidly, the stack method may prove very costly or impractical. Surrounding terrain and general atmospheric conditions must be known. Frequent snow at a location will do a more effective job of washing the atmosphere than rain showers. Other problems frequently met are the expected depth of frost penetration at a site, the frequency of very low temperatures, and the desire or need for air conditioning. In closing his talk, Mr. Gosline stressed the need for close co-operation between an industrial meteorologist and the Weather Bureau.

CHARLES F. BROOKS
BLUE HILL OBSERVATORY

THE AUTUMN that does not have, either late in October or in November, at least one period of warm weather that we know as Indian summer, is rare. Sometimes there are two distinct series of these days, separated by a colder spell; less frequently there are three; one such period is practically certain. In the midst of early cold days, when there has been heavy frost at night and ice has formed of mornings, and there has been bleak and stormy weather, there comes as a reprieve from winter a brief but glorious interlude of warmth and balminess. The landscapes are golden, set in an atmosphere of wonderful blue haze. It seems, indeed, that summer has come again, though on an autumn plane of average temperature.

Indian summer arrives in the transition period, as summer merges into winter, and the weather may assume alternately the characteristics of either season in a modified degree. The atmosphere is subject to less general agitation in the late fall than in the spring, when the air is in strong circulation between the heated South and the snow-covered North. There is less of turbulence generally and fewer local storms. Areas of high and low pressure pass less swiftly, and therefore when Indian summer comes, with some stagnant or slowly moving high centered in the South, the condition usually remains for a number of days.

How was Indian summer named? The most commonly accepted explanation is that the American Indians recognized it as a season certain to come at least once, and in some years more often, and depended upon it as a time for final preparation for winter, in the storing of their late crops, whatever these were, and in making ready their winter lodges. Another

version is that the early settlers attributed the blue haze to the smoke of fires set by the Indians on the western prairies. Some suggest the possibility of a naming by an early traveler, who, familiar with the dry, hazy weather of India, recognized a similar kind of weather here. The term "Indian summer" has been applied for some time by British mariners to the fine weather of the cool season on the Indian Ocean.

The beautiful blue haze of autumn is due chiefly to the presence of smoke in the atmosphere. Fall fires are all too frequent. Their smoke hangs low and travels far, because there is very little formation of vertical air currents which would serve to dissipate it. Air laden with wood smoke always looks blue when seen away from the sun. In the fall, the atmosphere, cooling from the bottom, is becoming more stable, which permits the hazy condition to persist a long while.

Every autumn some parts of the country suffer from drought and become tinder-dry, and the carelessness of man does the rest. If conditions favor, a fire may cover thousands of square miles with smoke as it drifts hundreds of miles across the land. If there be any compensation whatever for a vast waste of natural resources, it is the beauty of the blue haze of autumn, and its harmony with the gay-colored landscape.*

*Adapted by the author from his book, **Why the Weather.**

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WEATHER AND MAN

Hans H. Neuberger and **F. B. Stephens.** Prentice-Hall, Inc., New York, 1948. *272* pages. $3.75.

TO THE GENERAL PUBLIC, to the student who wants a survey of meteorology and climatology, and to those who need a reference book, this text certainly has its place. It is brief, in fact too brief, but is written in a style that makes it easy to read, and it is sprinkled with a number of pleasing cartoon-type illustrations.

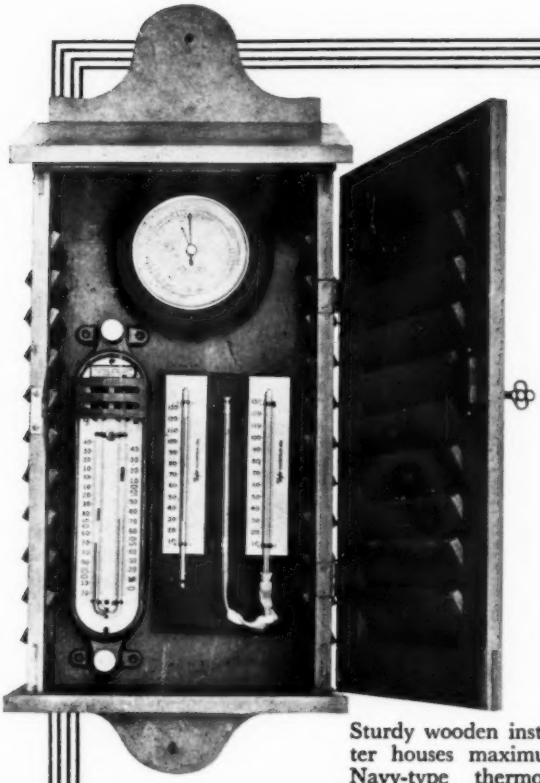
There are numerous good points. For example, there are two chapters headed, respectively, "Weather Phenomena of Stable Air" and "Weather Phenomena of Unstable Air," a nice, simple way to classify condensation forms. The reviewer wishes these chapters were more complete. As is common in so many beginning texts, there is a chapter on the United States Weather Bureau, with a most up-to-date discussion of the special services: Airways Weather, Five-day Outlooks, Agricultural and Horticultural, Fire Warning, River and Flood Forecasting, Hurricane Warning, Storm Warning, Frost Warning, and Climatological. Further, there are about four pages devoted to the interpretation of forecasts.

About one third of the book is strictly meteorology under the chapter headings: "The Atmosphere," "Energy, Earth, and Air," "Weather Elements," "Atmospheric Properties and Processes," "Air Masses," "Fronts," "Atmospheric Circulation," "Weather Phenomena of Stable Air," "Weather Phenomena of Unstable Air," and "Destructive Storms."

Interesting indeed is Part II, titled, "Why Do We Care." This shows the relation of weather to health, agriculture, architecture, aviation, shipping and transportation, public utilities, the housewife, and business and industry. "Weather and the Housewife" brings up a topic that is not found in other elementary texts. It does contain much advice on what to do, how to do it, and when to do it with respect to cooking, laundering, housecleaning, and bringing up children!

If this book is used as an introductory university or teachers college text for a one-semester course, there is no doubt it would be necessary to refer to more technical texts for student study, especially to enrich the sections on atmospheric processes and circulation. It certainly will be a popular reference book for all courses if for no other reason than the wide range of subjects discussed under "Why Do We Care."

P. E. CHURCH
University of Washington



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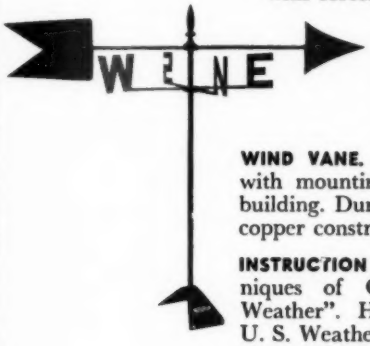

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FORECASTING THE WEATHER

Radar Goes Agricultural

GLENN E. STOUT

SENIOR ASSISTANT ENGINEER,
STATE WATER SURVEY, URBANA, ILLINOIS

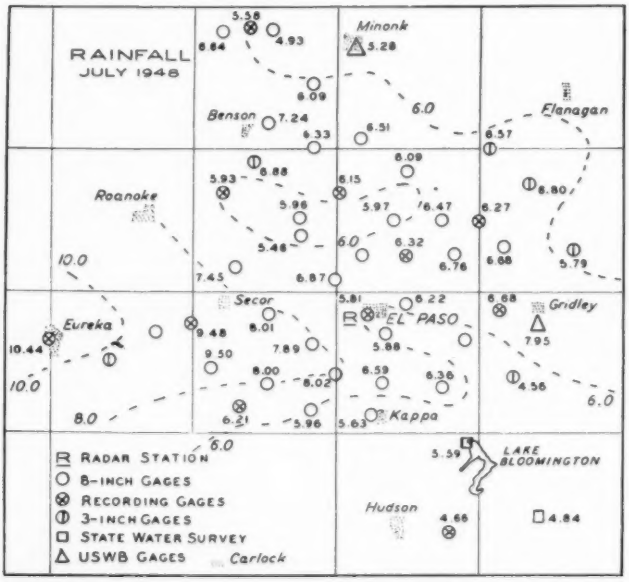
ON THE MORNING of July 27, 1948, Lester Pfister, president of the Pfister Hybrid Corn Company at El Paso, Ill., picked up his telephone to call station W9XVM and asked, "What's the weather, Dick?" Richard Price, the operator, answered, "Scattered light rain showers, 25 miles northeast of El Paso and moving eastward at 20 miles per hour. There is no rain to the west."

"Well, then I can send the detasseling crew into the field right away, and save $2,400." And in spite of the threatening skies, 1,200 detasselers were sent into the corn fields. This was a critical period in the growing of hybrid seed corn and every hour in the field was vital.

Station W9XVM is a war-surplus APS-15 radar which has been licensed by the Federal Communications Commission. It is located at the factory building of the Pfister Hybrid Corn Company, its gear originally used for navigation and bombing. It was purchased last winter, reconditioned and maintained by the State Water Survey, Department of Registration and Education, State of Illinois.

A jointly sponsored study of rainfall was organized by the two groups last spring. With the help of personnel and test equipment from the electrical engineering department of the University of Illinois the radar set was tuned to maximum sensitivity. At the same time a network of 46 rain gages was established, with the gages approximately two miles apart, as shown on the accompanying chart. There are 12 recording gages and 34 stick gages, the latter read daily by local residents, while the recording gages are serviced by the radar operator. Several war-surplus VHF radios have been licensed to maintain communication between the radar operator and a mobile radio unit.

Operating and maintaining a radar unit is not an easy task. It required 2,000 feet of wire to build cables to connect the various parts of the radar set. Spare parts for these sets are very expensive and not easily obtained on the civilian market, although some war-surplus radio dealers carry them. Power



The area of Illinois around El Paso, with township divisions (six miles square) shown. The dashed-line contours are for 10, 8, and 6 inches of rainfall in July, 1948. Note the location of the State Water Survey station at Lake Bloomington.

The penthouse installation, with the radar antenna enclosed in the radome and the modulator in the shelter. The radar room is situated just below the roof.

supplies are not common, for radar sets in general have been designed for military uses. This radar set, with some 85 tubes, hundreds of condensers and resistors, gives the maintenance man a few things to think about when shooting is needed. A specially designed test set is also required.

The first month of complete rainfall data from the 46 gages was July, 1948, as shown on the chart. Note the wide variation, such as between Eureka (10.44 inches) and at a station 10 miles northeast of Eureka (5.93 inches). The average rainfall for 42 stations was 6.63 inches, which is 3.62 inches above the 45-year average. This abundance of rainfall has been responsible for bumper crops this year.

From the network of rain gages, a study can be made of corn yield versus rainfall. But equally important for the Pfister Hybrid Corn Company, which detassels and picks about 5,000 acres of seed corn each year, is the use of the rain gages and radio communication to check on the accuracy of using radar for determining the areal extent of storms. The radar is not a prognosticator, but will indicate rain areas once they are formed. The operator can then plot their course and tell when a storm will strike the El Paso area. This is of great importance to those whose work depends on the weather, especially where seasonal crops must be tended at the right time, not tomorrow, but today. Accurate information as to actual time of rainfall within a few minutes is what a scientific farmer needs.

The radar equipment has already been helpful in the Pfister program. From photographic records, it will also be possible to correlate pictures of the radar scope with the rainfall records to determine whether a radar set might eventually replace the rain gages altogether.

Weather Exchange

Classified advertisements for this column are 8 cents a word, including address; minimum ad 20 words. Remittance must accompany orders. Write Weatherwise, AWA, The Franklin Institute, Phila. 3, Pa.

FOR SALE: Two like new Taylor barometers WB style, in inches and mbs, $22.50 each. Two like new Navy Fee and Stemwedel barometers, inches, $15.00 each. New radio receiver, 453-B 190-500 kc., converted to AC; with headphones, just plug in for weather reports, $30.00. One used 453-B converted for external power, 6.3 volts for filaments, 200 volts needed to operate it, plus your headphones, $12.00. Hollis Button, Valley City, N. D.

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LETTER TO THE EDITOR

Sir:

On Monday, July 19th, at about 6:00 p.m., a spectacular and unusual hailstorm hit the southern and eastern edges of Algona, Iowa, moving from southwest to northeast. It is believed the largest hailstones ever known here fell during the storm. This hail ranged from pea size to what may be classed as enormous.

I picked up two of the larger hailstones and found one to be 7½ inches in circumference, or slightly more than 2 1/3 inches in diameter. The other was nearly as big. The weight of the larger was 10 grains more than 2½ ounces. In shape both stones were like somewhat flattened spheres with the larger circumference fairly smooth and circular, but the top and bottom surfaces were very rough and jagged as if irregular pieces of ice had been frozen to them. When these were partly melted, the center of each hailstone was plainly visible, appearing round and about the size of a penny. The center was of a different shade from the rest of the hailstone, with light streaks radiating from it.

Some six or seven blocks southwest of me, V. K. Rising picked up a hailstone that was perfectly square, 2¼ inches on four sides, and about ¾ inch thick. Four blocks west of Mr. Rising's grain elevator, W. P. Hemphill measured several circular stones that were more than two inches in diameter. These two stones were flatter than those I found, but with jagged top and bottom surfaces. The large stones comprised probably not more than two per cent of those that fell.

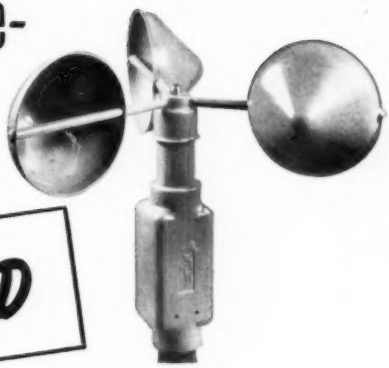
The storm first started about three miles south of Algona and moved almost straight north until it reached the edge of town, where it veered eastward. We were on the northwest edge of the main storm so that no hail at all fell in most of the town. The storm path was about two miles wide and six or seven miles long. From all points came reports of large and jagged stones such as fell here.

The storm moved very slowly, about 100 yards per minute, with almost no wind so the hailstones came straight down. Although the ground was nearly covered, surprisingly little damage was evident. Corn damage was perhaps 10 or 20 per cent; oats from 25 to 50 per cent, and most of the oats damage was due to high winds about one half to three quarters of an hour after the hail, blowing from west to east.

HARRY B. NOLTE
Weather Observer
Algona, Iowa

ED. NOTE: C. E. Lamoureux, section director of the U. S. Weather Bureau at Des Moines, who transmitted the above account, writes that hailstorms were reported the same evening from other points in northwestern Iowa, the most severe damage occurring at Ashton, about 70 miles west-northwest of Algona.

Just like you read time- you read the wind



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